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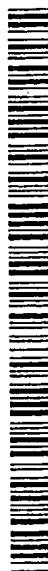
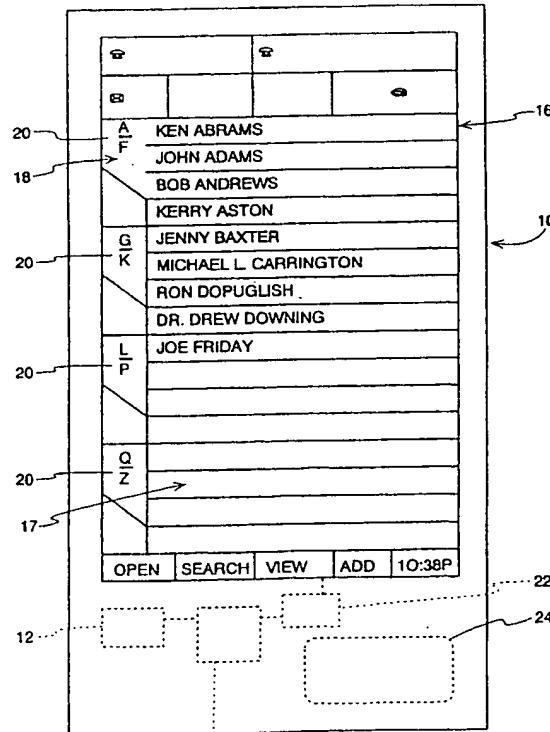
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(57) **Abstract:** A data display device including a memory for storing records, an information display, a processor, a display control and a user input. The processor organizes the data base records into groups, and includes a balancer for selecting groups whereby the number of records organized into each group are selectively similar. The display control controls the information display to indicate the discrete field ranges of the groups in a display organization area, and the records in a selected group in a display data area. The user input, such as touch sensitive areas, allows selection of a group to display in the data display area. A second input allows modifying the data base and the processor includes a rebalancer for selectively initiating the balancer after a selected modification of the data base. The displayed field ranges for each group may have upper and lower limits equal to the highest and lowest fields in the records of the group to indicate gaps to the user. The balancer determines (1) a selectively similar number of records C_0, C_1, \dots, C_{N-1} , for inclusion in each of N groups, and (2) the field range for each group according to overall ordered position of the records based on the field, with the first C_0 records placed in group 0, the next C_1 records placed in group 1, ... and the final C_{N-1} records placed in group $N-1$. This device uses the method of (1) determining the number N of groups, (2) placing the records in substantially equal numbers between the N groups based on a selected field of the records, (3) determining the ordered limits in the field for each group, and (4) displaying the determined ordered limits for each group for use by the user input.

DEVICE AND METHOD FOR DISPLAYING DATA

BACKGROUND OF THE INVENTION

TECHNICAL FIELD

The present invention is directed toward data displays, and more
5 particularly toward a device for displaying large data bases on small displays.

BACKGROUND ART

Many portable devices are today provided with a memory and display which enable the user to retrieve and view data stored in the memory.

Particularly in pocket-sized portable devices, the interface of the user
10 to large amounts of data can be difficult due to the requisite small size of the display provided therefor.

One common use for such devices is to maintain a data base of phone numbers. More and more commonly today, such data bases are used not only to convey the information to the user through a visual display, but also to interface with other uses of the device. For example, portable communication devices can include
15 a suite of applications for making telephone calls, sending faxes, producing email and SMS messages, and browsing the web, and the data base of information may be used to assist in those tasks. Commonly, a phone book is maintained in the device memory to provide such assistance (e.g., a user wishing to call John Jones may be able to do so merely by retrieving "John Jones" onto the display and then
20 suitably instructing the communication device to dial the number assigned to Mr. Jones in the data base).

Unfortunately, given the importance of such data bases and their often large sizes as well as the small display area, there can be difficulties in presenting
25 the information to the user in a way that does not require either a significant amount

of scrolling through the data base or a significant number of user inputs in order to retrieve the desired information.

One solution which has been used has been to break down the data into multiple groups and allow user input to select which of the groups is to be displayed. For example, divider tabs have been provided similar to those of old paper records, where the user may select a tab to get to a certain group. In phone listings, as one example, on larger devices such as computers having larger displays, tabs have been provided for virtually every letter of the alphabet, with the user able to click a pointer on one of the tabs to go to the listings for people having a last name beginning with the letter on that tab. In some cases, tabs have been provided for a range of letters to reduce the number of tabs. While this concept may also be used with devices having small displays such as discussed above so as to reduce the number of tabs so that they will be legible on the display (and usable, where selection of a tab may be done by fingertip touch which limits the number of discrete tab areas which may be effectively provided), for example by providing tabs for A-E, F-L, M-S and T-Z, this can result in inefficient use requiring significant and timely user input before the desired data is retrieved.

Specifically, each user has different requirements, and usually very different lists, which differences can result in inefficiency of use and burdensome input requirements. For example, a pilot's phone book may have a significant number of entries under "Hotel" and things called "Air...", whereas a local salesperson or doctor may have very few such entries. International factors can also significantly affect this, such factors being a serious concern for such devices which are often manufactured and sold for use internationally. For example, a businessperson in China might have significant numbers of names which begin with the letter L (e.g., Lin, Lee, Lu) and the latter letters in the alphabet (e.g., Yu, Xu, Wu, Wei, Wang, Zhang), whereas a businessperson in Scotland or Ireland might have significant numbers of names which begin with "Mc" (e.g., McDonald, McCarthy, McCartney).

Simply put, in virtually any phone book, there is the possibility that a significant proportion of the listings will fall under just one or two of the tabs. This can then significantly hinder the use of the list such as described above, since selecting a tab may not result in provision of a small list which can be readily displayed, but may 5 result in a very large list of names which will require either significant further input or significant scrolling therethrough in order to find the particular phone record of interest.

The present invention is directed toward overcoming one or more of the problems set forth above.

10 SUMMARY OF THE INVENTION

In one aspect of the present invention, a data display device for a data base having a plurality of records which may be organized according to a field in the records is provided, including a memory for storing the records, an information display, a processor, a display control and a user input. The processor organizes 15 the data base records into groups, and includes a balancer for selecting groups based on the records in the memory whereby the number of records organized into each group are selectively similar. The display control controls the information display to indicate the discrete field ranges of the groups in a display organization area, and the records in a selected group in a display data area. The user input allows selection of a group to display in the data display area.

20 In a preferred form, the user input comprises touch sensitive areas in the display organization area, whereby touching a touch sensitive area including the discrete field range of one of the groups selects the group and initiates the display control to indicate the records of the one selected group in the display data area.

25 In another preferred form, a second user input is provided for modifying the data base to add and delete records, and the processor further includes a rebalancer for selectively initiating the balancer after a selected modification of the

data base. In related preferred forms, the selected modification of the data base includes input relating to a selected number of records, or determination by a comparator that one of the groups has at least a selected number of records more than another of the groups.

5 In still another preferred form, the displayed field ranges for each group have upper and lower limits equal to the highest and lowest fields in the records of the group.

In yet another preferred form of this aspect of the invention, there are N groups and the balancer determines (1) a selectively similar number of records C_0 ,
10 C_1 , ... C_{N-1} , for inclusion in each group, and (2) the field range for each group according to overall ordered position of the records based on the field, with the first C_0 records placed in group 0, the next C_1 records placed in group 1, ... and the final C_{N-1} records placed in group N-1.

15 In another aspect of the present invention, a method of organizing and displaying multiple record data on a device having a display for selected records of the data and a user input for selecting the records to display is provided, including the steps of (1) determining the number N of groups, (2) placing the records in substantially equal numbers between the N groups based on a selected field of the records, (3) determining the ordered limits in the field for each group, and (4)
20 displaying the determined ordered limits for each group on the device display for use by the user input, whereby user input selecting the ordered limits for one group will cause display of records of the one group.

25 In one preferred form of this aspect of the present invention, the data may be modified and the above steps are repeated after a selected number of records have been modified in the modifying step. In a related form, the data may be modified and the above steps repeated when the compared numbers of records in each group is determined to have at least a selected number of records more than another of the groups.

In another preferred form of this aspect of the invention, the ordered limits for each group displayed in the displaying step have higher and lower limits equal to the highest and lowest field in the records in the group defined by such ordered limits.

5 In still another preferred form of this aspect of the invention, the placing step includes (1) ordering the records according to the selected field, (2) selecting similar numbers of records C_0, C_1, \dots, C_{N-1} , for inclusion in each group, and (3) placing the first C_0 ordered records in group 0, the next C_1 ordered records in group 1, ... and the final C_{N-1} ordered records in group N-1.

10 It is an object of the invention to provide a data display device and method of displaying data which may be easily and quickly used with all data distributions.

BRIEF DESCRIPTION OF THE DRAWINGS

15 Figure 1 is a plan view of a communication device incorporating the present invention;

Figure 2 is a flow chart of the Balance routine of the present invention;

Figure 3 is a flow chart of the Initialize subroutine of one exemplary embodiment of the present invention;

20 Figure 4 is a flow chart of a Separate subroutine usable with the Fig. 3 embodiment of the present invention;

Figure 5 is a flow chart of a Label subroutine usable with the Fig. 3 embodiment of the present invention;

Figure 6 is a flow chart illustrating adding data records to a communication device incorporating the present invention;

25 Figure 7 is a flow chart illustrating deleting data records to a communication device incorporating the present invention; and

Figure 8 is a flow chart of a Rebalance subroutine usable with a communication device incorporating the present invention and permitting modification of the data records such as illustrated in Figs. 6-7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

5 A device 10 according to the present invention is illustrated in Fig. 1. The device 10 may, for example, be a communication device which permits wireless communication by cellular or other networks.

10 The device 10 includes a memory 12 for storing, *inter alia*, a data base, which data base consists of individual records or entries, with each record being made up of one or more fields. In the preferred embodiment, and in the discussion herein, the data base could be a phone book with fields for last name, first name, address, phone number, etc., with the records sorted alphabetically based on the last name field. If the device 10 is a wireless communication device, the phone book can be integrated with operation of the device 10 where, for example, a phone 15 number in the data base can be dialed without the user having to dial the number. It should be understood, however, that the present invention could be used with different data bases, with the field on which the records are sorted being non-alphabetic.

20 In one preferred embodiment, the device 10 further includes a processor 14 adapted to, *inter alia*, organize the data base records into groups or slots as explained further below.

25 An information display 16 is also provided, including a data display area 17 and an organization area 18 (in the illustrated embodiment, the area along the left side of the display 16 in which the data divider tabs 20 are displayed), with a display control 22 for controlling the information display 16 to indicate the tabs 20 with discrete field ranges or limits of the groups in the organization area as described further below, and displays records in a selected group in the data display area 17.

In one preferred embodiment, the information display 16 is touch sensitive to allow user input. Such display screens are known in the art and are not described in detail herein. In the illustrated embodiment, in accordance with the present invention, the organization area 18 is touch sensitive whereby a user may touch the area of one of the tabs 20 which will cause the display control 22 to display the data records falling in the group identified by the limits on the touched tab 20. Still other user touch input can be provided as well, for example, where touching the name associated with a record as displayed in the data display area 17 will cause the data display area 17 to display the full record associated with that name.

In a preferred embodiment, another user input is provided to allow the data base to be modified, with the user having the ability to add, delete and/or modify records. Such an input can be provided by a keypad (such as in the area 24 shown in Fig. 1), or can be through the screen as well (such as is well known in pocket data devices such as Palm Pilots).

An exemplary flow chart illustrating one preferred operation of the device 10 (and corresponding method) of the present invention is illustrated in Figs. 2-8.

Overall operation is shown in the Balance routine of Fig. 2, which initiates at box 30. Initially in the routine, various values are set according to the particular application. Specifically, the number of letters (in alphabetic listings) L is selected at box 32. Typically, L would be 2 for alphabetic listings in (as indicated in box 32, a range of Mc-Ne is exemplary of L=2, whereas a range of M-R is exemplary of L=1). Also, in box 34, the number N of slots to be shown indexed is set (typically beginning with slot 0 so that the slots number from 0 to N-1). For example, N would be the number of tabs illustrated in the organization area 17 of the display. In box 36, array S is set of size N to hold entries in each slot (as determined in the Initialize subroutine as described below). Finally, in box 38, the number of entries E to be distributed in the array is set (with the first entry typically being number 0 so that the

last entry is E-1). Entries E are typically simply the number of records in the data base.

The Initialize subroutine (box 40) is then run. This subroutine, which is shown in Fig. 3, begins at box 42 by establishing two numbers, with e set as E and n set as N ($e=E$; $n=N$). At box 44, "i" (which indicates the slot number) is set at 0. The subroutine then loops through boxes 44-56 N times (*i.e.*, one time for each slot) to set the number of records to be included in each slot. Specifically, ceiling c (which is the preferred number of records to include in the slot) is first calculated simply as e/n in box 46. In a preferred form, "c" in each iteration through the initialize subroutine will be rounded up or down to an integer. In the first pass, this establishes the preferred number of records for the first slot ($S(0)$), after which "i" is incremented to the next slot (in box 50) and "e" and "n" are adjusted (boxes 52, 54) so that in the next pass the remaining records are distributed among the remaining slots. Thus, the second pass establishes the preferred number of records in the second slot ($S(1)$), and so forth, until a number "c" has been established for all N passes, at which point $n = 0$ in box 56 and the subroutine stops (box 58) and returns to the Balance routine and runs the Separate subroutine (box 60).

It should be appreciated that in a simple example with 30 records to be distributed among 4 groups (*i.e.*, $E=30$ and $N=4$), the Initialize subroutine will set $S(0)=8$, $S(1)=8$, $S(2)=7$ and $S(3)=7$ when "c" is rounded down (meaning simply that it is preferred to have 8 records in slots 0 and 1 and 7 records in slots 2 and 3), and will set $S(0)=7$, $S(1)=7$, $S(2)=8$ and $S(3)=8$ when "c" is rounded up.

At this point, each of the slots $S(i)$ will have the selected number of records assigned to them according to the desired sequence of the data base. That is, the Initialize subroutine first determined the selectively similar number of records C_0 , C_1 , ... C_{N-1} , for inclusion in each group, and then the first C_0 records are placed in group 0, the next C_1 records placed in group 1, ... and the final C_{N-1} records placed in group N-1. For example, in the 30 record, 4 group example previously mentioned,

slot S(0) will have the alphabetically first 8 (or 7) records, etc., with slot S(3) having the alphabetically last 7 (or 8) records. Such sorting can be accomplished by any suitable algorithm. *Data Structures and Algorithms in Java* by M. Goodrich and R. Tamassia (John Wiley and Sons 1998), the complete disclosure of which is hereby incorporated by reference, is one of many textbooks which teach algorithms which may be used for this purpose.

The Separate subroutine (box 60) is then run. This subroutine, which is shown in Fig. 4, begins by setting "i" to 0 (box 62), whereby the subroutine will initially determine range limits of the records in slot 0 (S(0)). Since there is more than one slot (*i.e.*, $N \geq 2$, so that $N-1 \geq 1$, and therefore in the first path [with $i=0$] $i < N-1$, the answer to box 64 will be Yes), in the first pass through the Separate subroutine, the limit ll of the selected L letters of the last record in the first slot S(0) and the limit mm of the selected L letters of the first record in the second slot S(1) will be determined in boxes 66, 68 (e.g., in the example where $L=2$, the first two letters of the last alphabetical record in slot 0 and the first two letters of the first alphabetic record in slot 1 are determined). Those two are compared in box 70 and, if they are not equal, processing proceeds to box 72 where "i" is iterated for the next pass (to compare the limits between the records at the end of the second slot and the beginning of the second slot). Such processing continues until all of the adjacent limits are determined, at which point $i < N-1$ in box 64 and the Separate subroutine will stop, and the Label subroutine (box 90 in Fig. 5) will begin.

In circumstances where $ll=mm$ (that is, where two slots have records with the same first L letters, such as "Johnson" at the end of slot 0 and "Jones" at the start of slot 1), it is preferred to move the records to be together (e.g., so that the "Jo" limit will be on just one tab). Therefore, in the exemplary embodiment illustrated in Fig. 4, a comparison is done (in boxes 74 and 76) to see how even the records will be distributed among the slots if the ll records are moved into the next slot versus the evenness of the record distribution if the mm records are moved into the previous

-10-

slot. If (at box 78) there is less unevenness by moving the mm records up to the previous slot S(i), then the mm records are moved up (box 80) to previous slot S(i), but if moving the ll records down to the next slot will result in less unevenness (*i.e.*, a more even distribution of numbers of records between the slots), then the ll records
5 are moved down to the next slot S(i+1). As illustrated in box 78, the records are preferably moved down if unevenness would be the same either way, but they could also be moved up as well.

10 An example of the above is as follows, with 7 records (Anna, Bharat, Billy, Brian, David, Donald and Eeyore) distributed among 3 slots, with L=1 (*i.e.*, records sorted only on their first letter).

The Initialize subroutine will (when "c" is rounded up) derive c(0)=3, c(1)=2 and c(2)=2. Thus the initial distribution of records will be as follows:

15 S(0): Anna, Bharat, Billy
 S(1): Brian, David
 S(2): Donald, Eeyore

In accordance with the Separate subroutine, ll (B of Billy) = mm (B of Brian). Accordingly, a test is made for unevenness based on the B records shifting between S(0) and S(1). If Brian is shifted up to S(0), the record distribution would then be:

20 S(0): Anna, Bharat, Billy, Brian
 S(1): David
 S(2): Donald, Eeyore,

with the up-unevenness 3 (4-1). If by contrast, Bharat and Billy are shifted down, the record distribution would be:

25 S(0): Anna
 S(1): Bharat, Billy, Brian, David
 S(2): Donald, Eeyore,

also yielding a down-unevenness of 3.

In accordance with the Separate subroutine, and specifically decision box 78, since the unevenness would be the same in either case, the "ll" entries in slot 0 (Bharat and Billy) would be moved up to slot 1. Proceeding in the Separate subroutine for the next slot, there is again an overlap where ll (D for David in slot 1) = mm (D for Donald in slot 2). The process of boxes 74-82 are thus repeated for these two slots (1 and 2), yielding a greater unevenness for up shifting (resulting in 5 records in slot 1) so that the down shifting would be selected, resulting in:

5 S(0): Anna
10 S(1): Bharat, Billy, Brian
10 S(2): David, Donald, Eeyore.

It can be appreciated that this distribution would be balanced and highly efficient for L=1.

15 At the above described point, following the Separate subroutine, the records of the data base have been evenly distributed between the N number of slots. The Label subroutine (Fig. 5) then essentially determines what labels should be displayed to indicate the limits of the slots to the user.

20 Initially, the Label subroutine determines the first and last limits, with Start (0) being the first letter that begins the entries in the first slot (box 92), and Stop (N-1) being the last letter that begins the entries in the last slot (box 94). It should be appreciated that since these two limits are not next to a limit in another slot there is typically (i.e., there is nothing before the first entry and nothing after the last entry), it will be necessary only to indicate a single letter although L letters could be shown if desired to more fully illustrate the lack of specific entries (e.g., a first limit of "Ar-" would indicate that there are no "Adams" without having to look at the records).

25 Processing of the Label subroutine then continues for the first slot (where i=0 as set in box 96). Such processing loops around continuously until labels have been established for each slot as a result of boxes 98 and 100 in the manner

essentially the same as accomplished by boxes 64 and 72 of the Separate subroutine.

In each iteration or loop of the subroutine, the last string II of L letters that begins the entries of the slot for the current loop ($S(i)$) is found (box 102), as are the first string mm of L letters that begins entries in the next slot ($S(i+1)$) (box 104).
5 Due to the Separate subroutine, and specifically boxes 74-82, II will not equal mm as previously described. K is set (box 106) as the length of the common prefix of II and mm (e.g., K=0 where the last record in slot 0 is "Irwin" and the first record in slot 1 is "Johnson", and K=1 where the last record in slot 0 is "James" and the first record in
10 slot 1 "Johnson"; with it being appreciated that $K < L$ since II will not equal mm as explained above). The labels for the Stops and Starts of adjacent slots are then assigned with lengths of at least K+1 (boxes 108, 110). For example, in the given example with K=0, slot 0 would have a Stop of "I" and slot 1 would have a Start of "J", whereas in the example of K=1, slot 0 would have a Stop of "Ja" and slot 1 would
15 have a Start of "Jo".

It should be appreciated that labels according to the above will not only be automatically established so that the records will be evenly distributed between the slots no matter what the alphabetic distribution of the records in the data base, which distribution will greatly simplify and quicken accessing the records on small displays. Further, where the labels are set to correspond to the records in each slot,
20 the user can also quickly recognize that a certain record is not present (e.g., if slot 0 has a Stop of "Ja" and slot 1 has a Start of "Jo", the user need not review any records to recognize that there is no record for "Jerrold").

In most devices of the type with which the present invention is
25 advantageously usable, the data base is not static but may be modified by the user to insert and delete records. Accordingly, the processor is also preferably programmed to rebalance the records among slots by a routine such as the Rebalance subroutine illustrated in Figs. 6-8.

Specifically, when a record is inserted or added (box 120, Fig. 6), the slot where the entry would go is first determined (box 122), the added entry is placed in that slot (box 124), the determined array for the number of records in that slot is incremented up one (box 126), and then processor then skips (box 128) to the
5 Rebalance subroutine. Similarly, when a record is deleted (box 130, Fig. 7), the slot where the record had been placed is first determined (box 132), the record is removed (box 134), the determined array for the number of records in that slot is reduced down one (box 136), and then processor then skips (box 128) to the Rebalance subroutine.

10 In a preferred form, the records are only periodically redistributed in order to reduce processor requirements and power usage as well as to avoid user confusion (for example, if the Labels are constantly changing, a user may become both confused and frustrated). In accordance with this preferred form, the Rebalance subroutine (Fig. 8) keeps track of the number of modifications made to the
15 records and only rebalances the records after a preset number of modifications have been made. As illustrated in the Fig. 8 embodiment, this is accomplished by incrementing the number M of modifications (box 140) each time the Insert or Delete subroutines (Figs. 6-7) are used. If the number of modifications are less than the preset number (ModLimit in box 142), then the records are not rebalanced among
20 the slots and instead the Label subroutine (Fig. 5) is initiated (box 144). If, however, enough modifications have been made so that the limit is reached (M is not less than ModLimit), then the Rebalance subroutine continues. In the preferred embodiment illustrated in Fig. 8, the number M of modifications is reset to 0 (box 146) and the unevenness between the slots is measured. If the unevenness does not exceed a
25 preset limit U (e.g., no one slot has a total number of records which is U more or less than the total number of records in any other slot), then the records are still not rebalanced among the slots and the Label subroutine (Fig. 5) is initiated (box 144). However, if the limit of modifications has been made and this has resulted in a level

of unevenness of distribution of the records among the slots which is greater than the set limit (*i.e.*, $M=ModLimit$ and $unevenness>U$), then the entire Balance routine is initiated again (box 30).

It should now be appreciated that the present invention will accommodate virtually any distribution of records in a data base to automatically result in selectively even distribution of records among slots or groups. Thus, devices incorporating this invention can be readily and easily used by people around the world, notwithstanding the different distributions of their data as previously described.

Still other aspects, objects, and advantages of the present invention can be obtained from a study of the specification, the drawings, and the appended claims. It should be understood, however, that the present invention could be used in alternate forms where less than all of the objects and advantages of the present invention and preferred embodiment as described above would be obtained.

CLAIMS

1. A data display device for a data base having a plurality of records which may be organized according to a field in said records, comprising:

5 a memory for storing said records;

an information display including a data display area and an organization area;

a processor for organizing said data base records into groups, including a balancer for selecting groups based on said records in said memory whereby the number of records organized into each group are selectively similar, said groups being defined by discrete ranges in the field used to organize the records,

10 a display control for controlling said information display to indicate

the discrete field ranges of the groups in the organization area, and the records in a selected group in the data display area; and

15 a user input for selecting a group to display in the data display area of the information display.

2. The device of claim 1, wherein said user input comprises touch sensitive areas in said information display organization area, whereby touching a touch sensitive area including the discrete field range of one of the groups selects said group and initiates said display control to indicate the records of said one selected group in the data display area.

3. The device of claim 1, wherein:

said device further includes a second user input for modifying said data base to add and delete records; and

25 said processor further includes a rebalancer for selectively initiating said balancer after a selected modification of said data base.

4. The device of claim 3, wherein said selected modification of said data base includes input relating to a selected number of records.

5. The device of claim 3, further comprising a comparator for determining the different numbers of records in each group, wherein said rebalancer initiates said balancer in response to said comparator determining that one of the groups has at least a selected number of records more than another of the groups.

6. The device of claim 1, wherein each discrete field range displayed in said organization area has a lower limit equal to the lowest field in the records in the group defined by such discrete field range.

10 7. The device of claim 6, wherein each discrete field range displayed in said organization area has an upper limit equal to the highest field in the records in the group defined by such discrete field range.

15 8. The device of claim 1, wherein the field in said records is alphabetic, and said field in said discrete field ranges of the groups are alphabetically organized.

9. The device of claim 1, wherein there are N groups and said balancer determines:

a selectively similar number of records C_0, C_1, \dots, C_{N-1} , for inclusion in each group, and

20 said field range for each group according to overall ordered position of said records based on said field, with the first C_0 records placed in group 0, the next C_1 records placed in group 1, ... and the final C_{N-1} records placed in group N-1.

10. A method of organizing and displaying multiple record data on a device having a display for selected records of the data and a user input for selecting the records to display, comprising the steps of:

5 determining the number N of groups;

 placing the records in substantially equal numbers between said N groups
 based on a selected field of said records;

 determining the ordered limits in the field for each group; and

 displaying the determined ordered limits for each group on said device
 display for use by the user input, whereby user input selecting the
10 ordered limits for one group will cause display of records of said one
 group.

11. The method of claim 10, wherein user input is provided by touching the display where the ordered limits for the one group is displayed.

12. The method of claim 10, further comprising the steps of:
15 modifying the data by adding and deleting records; and
 repeating the steps of claim 10 after a selected number of records have been
 modified in the modifying step.

13. The method of claim 10, further comprising the steps of:
 modifying the data by adding and deleting records;
20 comparing the different numbers of records in each group, and
 repeating the steps of claim 10 if one of the groups is determined in the
 comparing step to have at least a selected number of records more
 than another of the groups.

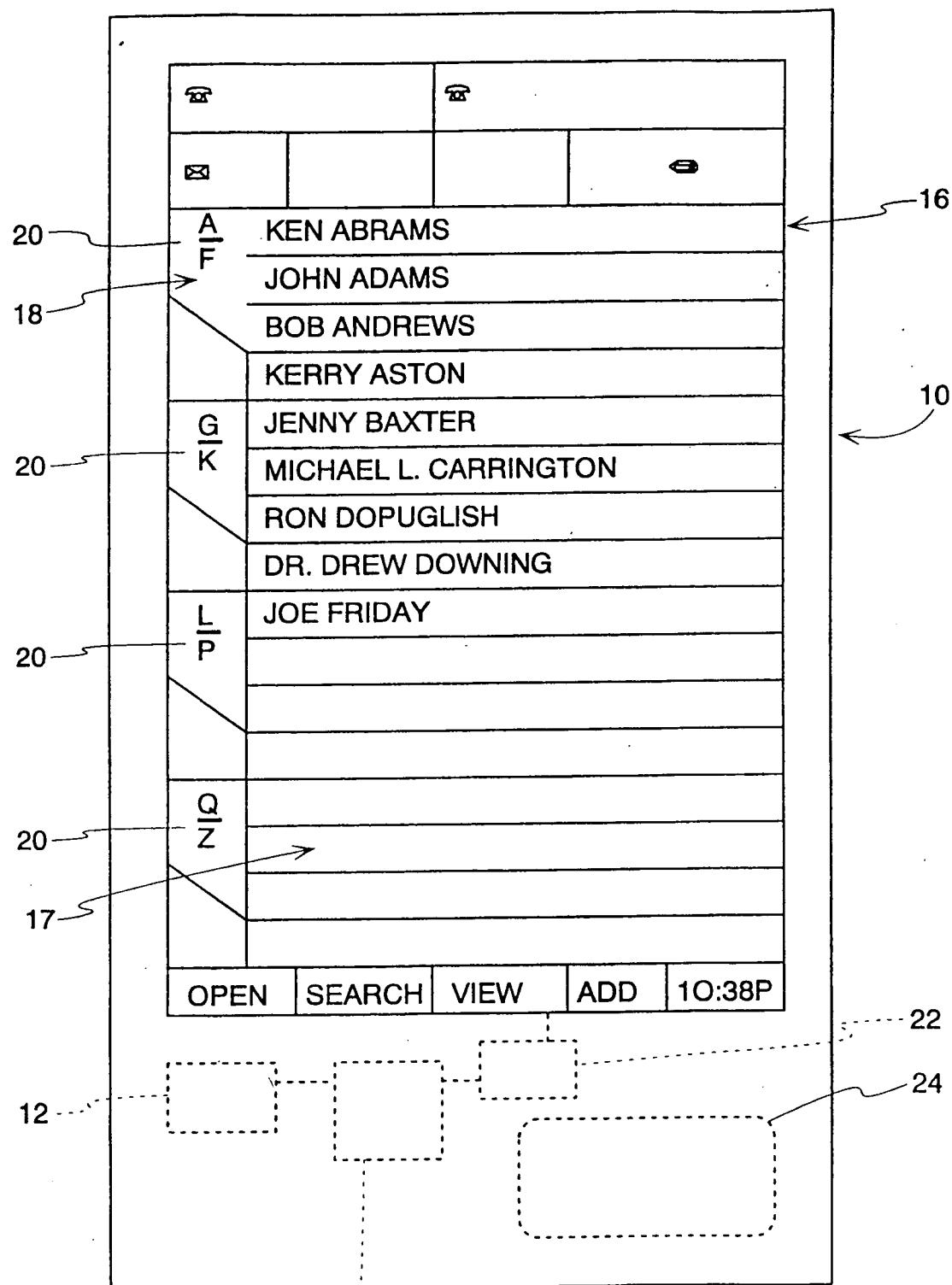
14. The method of claim 10, wherein the ordered limits for each group displayed in the displaying step have a lower limit equal to the lowest field in the records in the group defined by such ordered limits.

5 15. The method of claim 14, wherein the ordered limits for each group displayed in the displaying step have an upper limit equal to the highest field in the records in the group defined by such ordered limits.

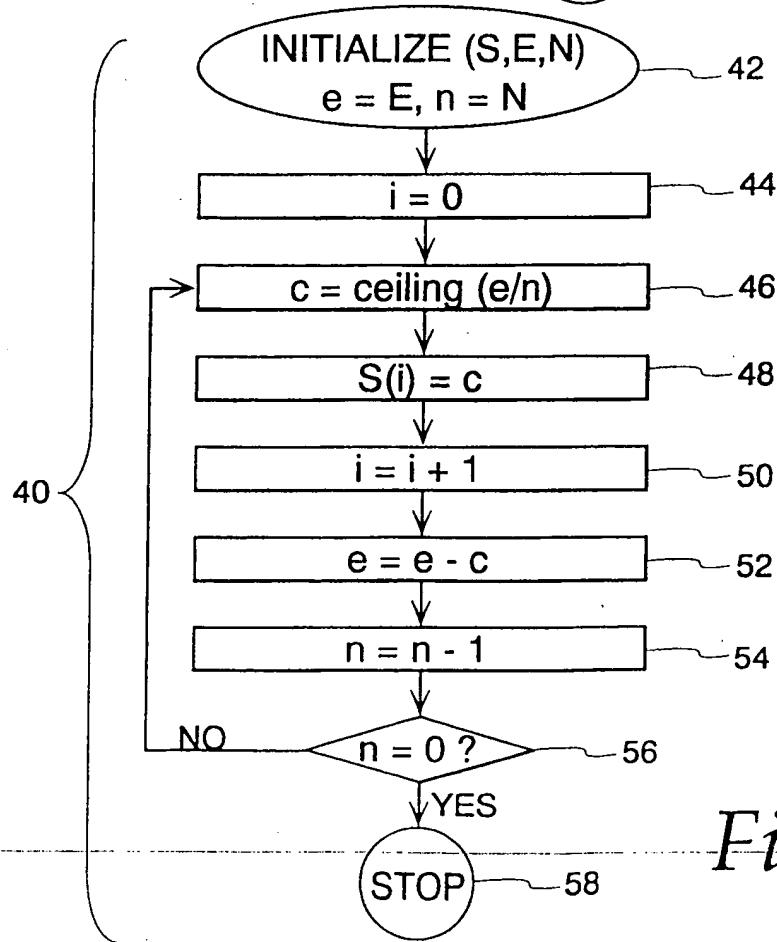
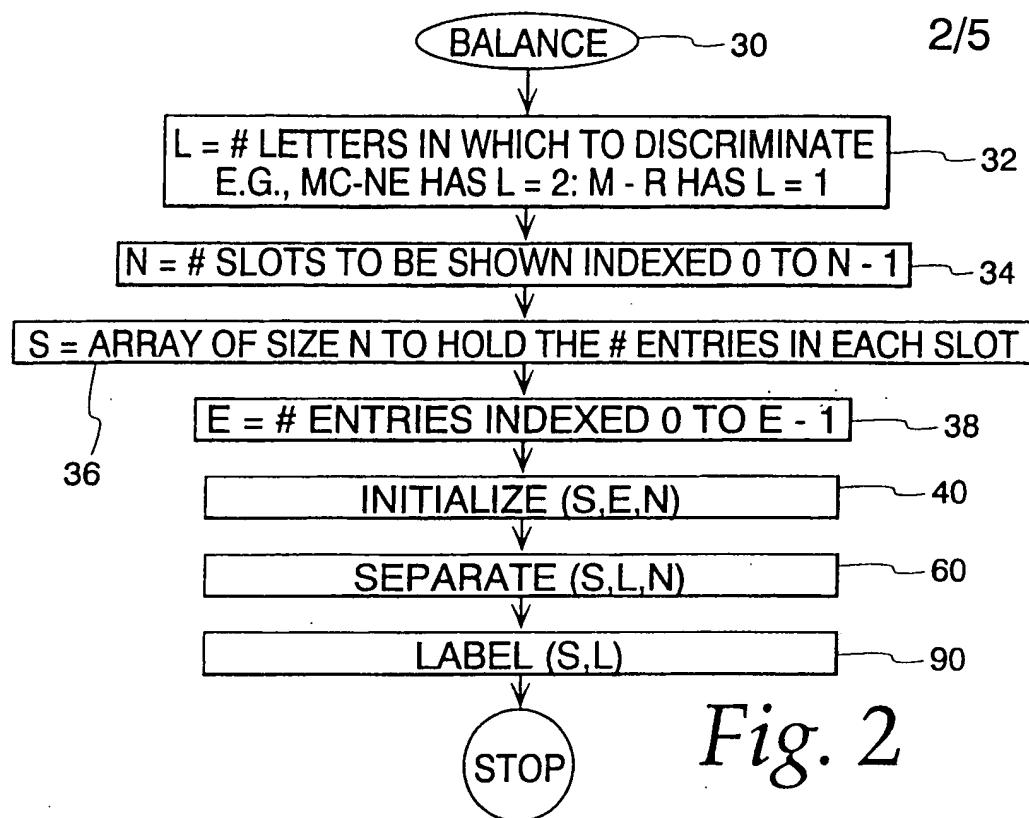
16. The method of claim 10, wherein the field in said records is alphabetic, and said field in said discrete field ranges of the groups are alphabetically organized.

10 17. The method of claim 10, wherein said placing step comprises:
ordering the records according to the selected field;
selecting similar numbers of records $C_0, C_1, \dots C_{N-1}$, for inclusion in each group; and
placing the first C_0 ordered records in group 0, the next C_1 ordered records in
15 group 1, ... and the final C_{N-1} ordered records in group N-1.

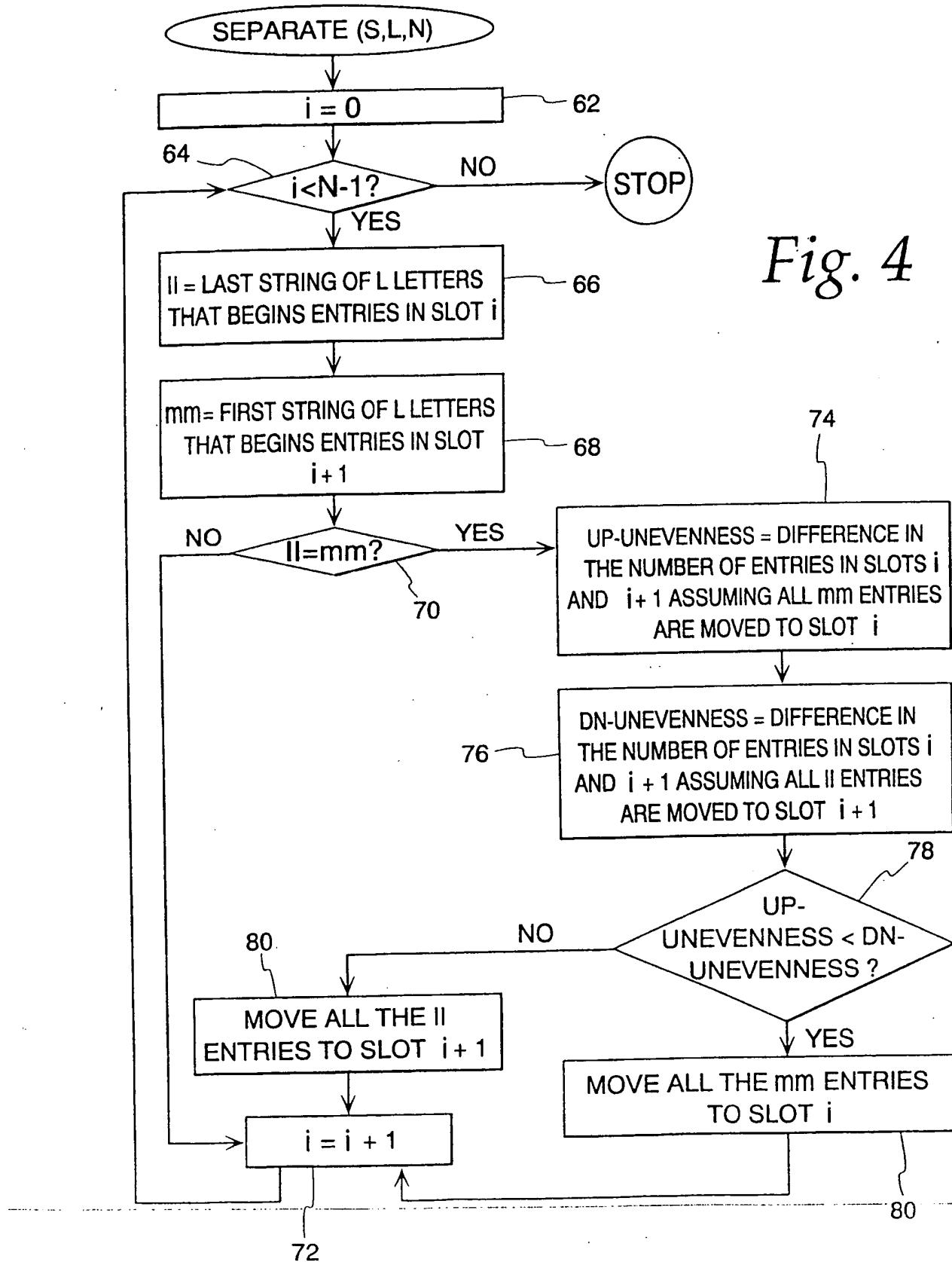
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¹⁴ Fig. 1



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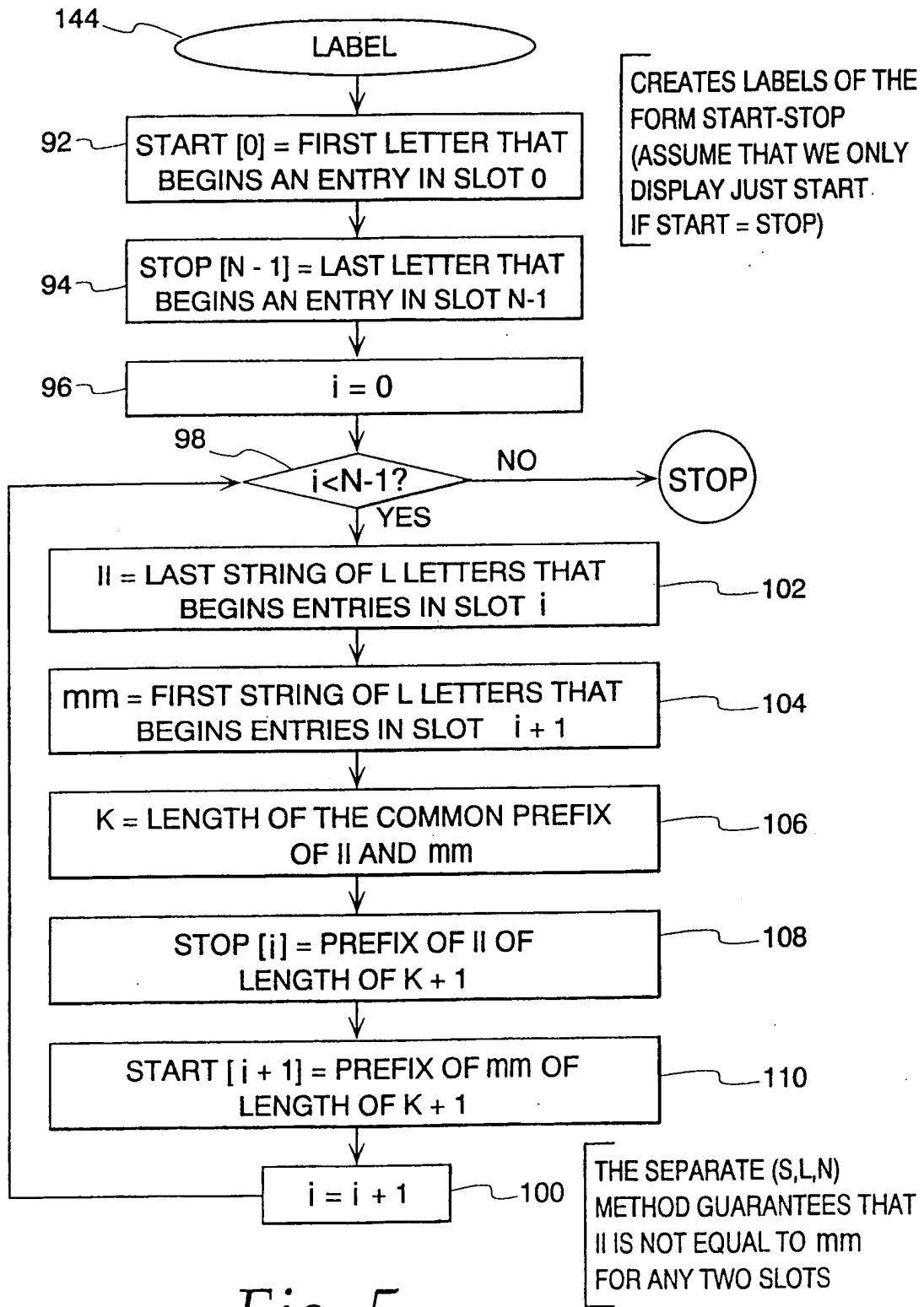
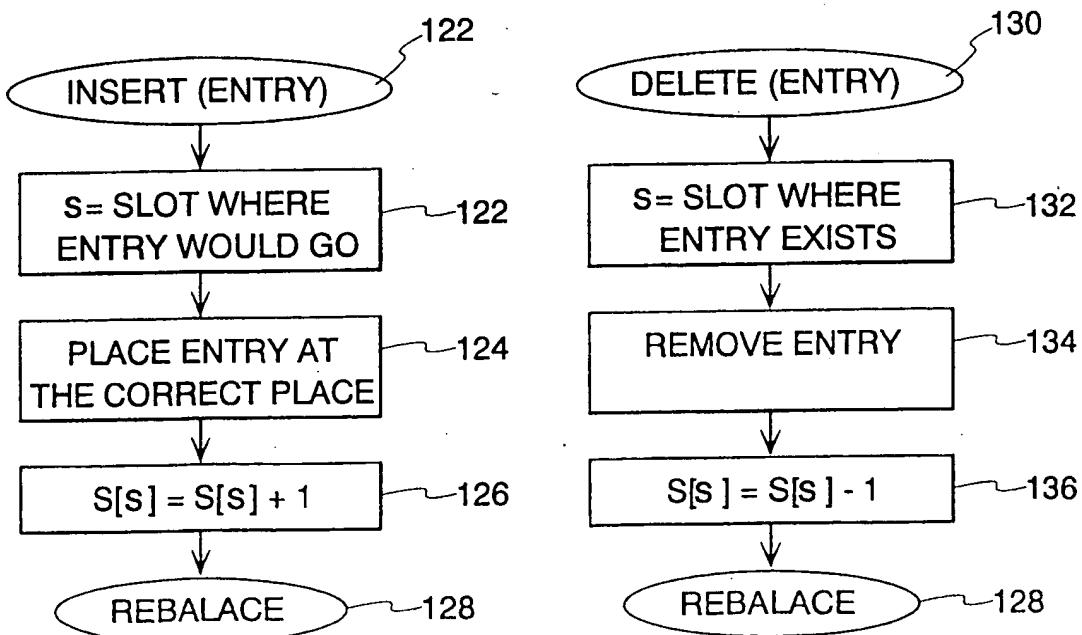
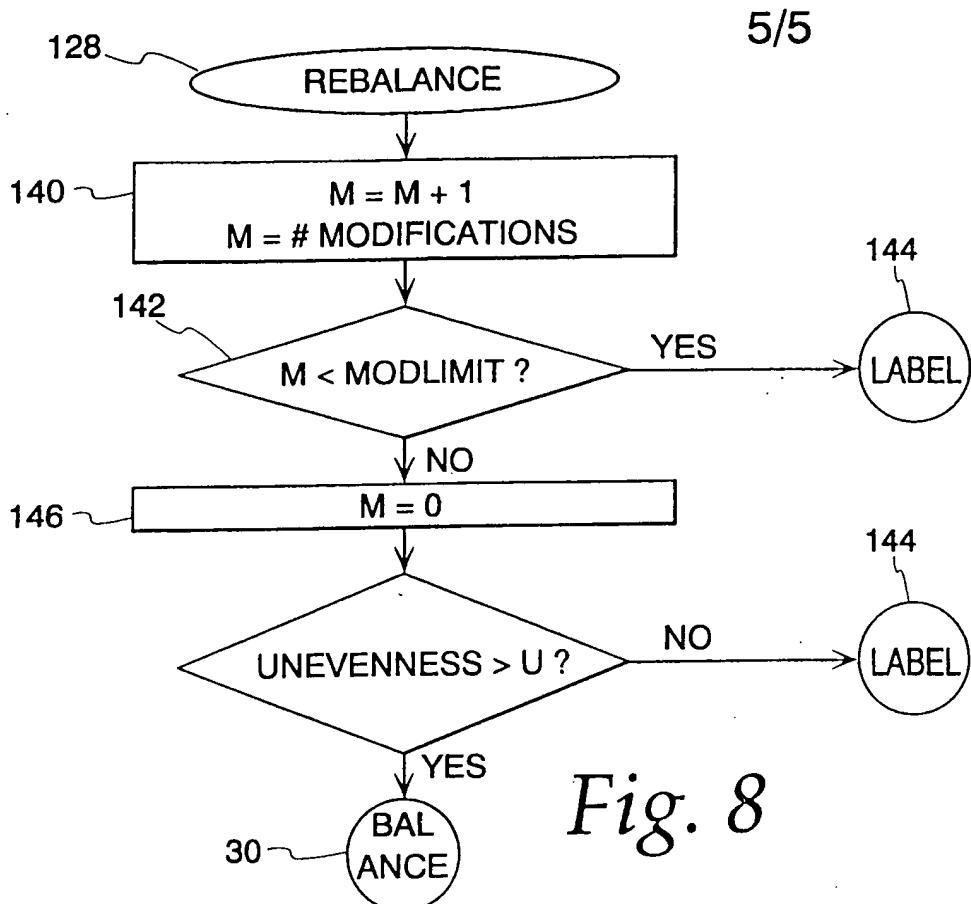


Fig. 5

*Fig. 6**Fig. 7*